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Maritimes Region

Canadian Science Advisory Secretariat
Science Response 2016/010

STOCK STATUS UPDATE OF ATLANTIC HALIBUT ON THE SCOTIAN SHELF AND SOUTHERN GRAND BANKS (NAFO DIVS. 3NOPs4VWX5Zc

Context

Atlantic Halibut (*Hippoglossus hippoglossus*) is the largest of the flatfishes and ranges widely over Canada's East Coast. The management unit definition (3NOPs4VWX5Zc) is based largely on tagging results, which indicate that Atlantic Halibut move extensively throughout the Canadian North Atlantic, with smaller fish moving further than larger fish.

The Atlantic Halibut fishery was unregulated until a total allowable catch (TAC) was implemented in 1988 and a legal size limit (≥81 cm total length) was established in 1994. The Fisheries and Oceans Canada (DFO) research vessel (RV) survey provides an index of abundance for incoming recruitment. An industry-DFO longline Halibut Survey on the Scotian Shelf and southern Grand Banks (3NOPs4VWX5Zc) was initiated in 1998 to provide an index of exploitable (≥81 cm total length) halibut on the Scotian Shelf and southern Grand Banks. A new assessment model and assessment procedures were adopted in November 2014, to inform Fisheries and Aquaculture Management (FAM) of the status of the Halibut resource and to provide harvest level advice based on standardized catch rates from the industry-DFO Halibut Survey and stratified mean numbers per tow from the RV survey. Science advice provided in December 2014 used this new procedure (DFO 2015).

This stock status update was requested by FAM to update and evaluate abundance indicators, landings and fishing mortality estimated from tagging data. This response provides 2016-2017 TAC advice based on the Objectives and Harvest Strategy adopted at the Scotia-Fundy Groundfish Advisory Committee (SFGAC) meeting in March 2015.

This Science Response Report results from the Science Response Process of December 3, 2015, on the Stock Status Update of Halibut in Northwest Atlantic Fisheries Organization (NAFO) Fishing Area 3NOPs4VWX5.

Background

Biology

Atlantic Halibut (*Hippoglossus hippoglossus*) is the largest of all flatfish and ranges widely over Canada's East Coast. They are demersal, living on or near the bottom. Atlantic Halibut are most abundant at depths of 200-500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter. The geographic range of Atlantic Halibut in the Northwest Atlantic extends from the coast of Virginia in the south to the waters off northern Greenland.

Female Atlantic Halibut grow faster than the males and attain a much larger maximum size. Atlantic Halibut grow rapidly (approximately 10cm per year) until the age of maturity, which for this region is estimated to be at 77 cm for males (age 5-6) and 119 cm for females (age 9-10).

Description of the Fishery

The management unit definition (3NOPs4VWX5Zc, Figure 1) was based largely on tagging results that indicated that Atlantic Halibut move extensively throughout the Canadian North Atlantic (Stobo et al. 1988). Within the management unit, halibut is fished mostly along the edges of the continental shelf mainly by longline. Until 1988, the fishery was unregulated. A TAC of 3,200 mt was first established in 1988 and was reduced to a low of 850 mt in 1995, in response to an eight year decline in landings. Since 1994, management plans and licence conditions require the release of halibut less than 81 cm. Beginning in 1999, the TAC has been increased several times and was set at 2,738 mt in 2014 (Table 1; Figure 2).

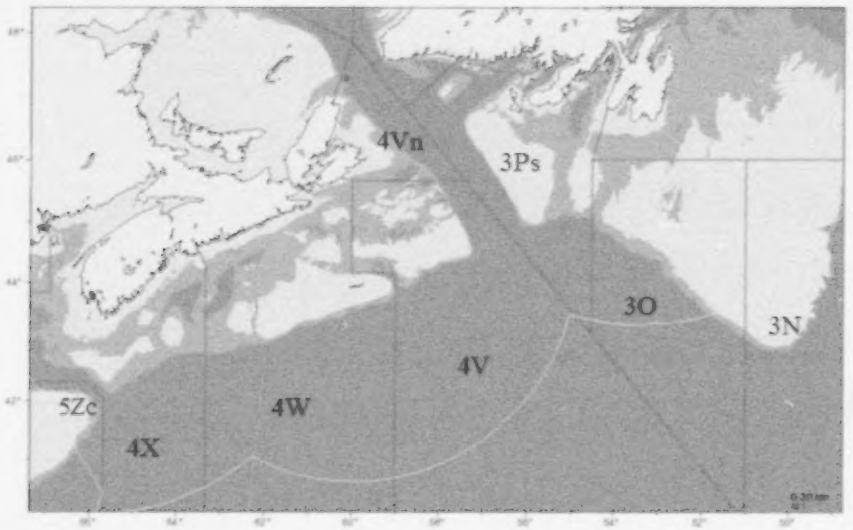

Figure 1. Management unit 3NOPs4VWX5Zc.

NAFO statistics are used to describe removals because landings occur in two DFO regions (Maritimes and Newfoundland) and outside Canada's Exclusive Economic Zone (EEZ), as well as, from other countries including Portugal, Spain, and France. The 2013 and 2014 Northwest Atlantic Fisheries Organization (NAFO) landings may be underestimated, as there is often a delay in reporting. Also, at the time of this report, the 2015 fishing season was ongoing; thus, the 2015 landings data are incomplete. Most of the halibut landed are caught on the Scotian Shelf (4VWX). In 2014, landings reported in NAFO's STATLANT 21 database increased on the southern Grand Banks (3NOPs) and declined slightly in 4VWX (Table 1). Of the 1079 mt landings reported for 3NOPs in 2014, 241 mt were landed by countries other than Canada, which is up from 120 mt foreign landings in 3NOPs in 2013.

Table 1. Total reported Canadian and foreign landings (metric tonnes) of Atlantic Halibut from NAFO divisions 3NOPs4VWX5Zc[1]. Ten year annual average landings are presented for 1960 to 2009.

		Landings			Landings[3]	Canadian TAC[4]
	Year(s)	3NOPs	4VWX	5Zc[2]	3NOPs4VWX5Zc	3NOPs4VWX5Zc
Decadal Average	1960-69	996	1464	-	2460	-
Decadal Average	1970-79	487	851	-	1338	-
Decadal Average	1980-89	955	1561	50	2566	-
Decadal Average	1990-99	503	790	30	1323	1855
Decadal Average	2000-09	607	863	15	1484	1318
Annual	2010	556	1279	11	1846	1850
Annual	2011	475	1322	19	1816	1850
Annual	2012	643	1460	29	2132	2128
Annual	2013	682	1799	33	2514	2447
Annual	2014	1079	1775	20	2874	2563
Annual	2015[5]	-	-	-	2360	2738

[1] Landings 1960-2014 from NAFO Table 21A as of November 18, 2015.
[2] Landings were first listed in 5Zc in 1986.
[3] NAFO Table 21A reported by calendar year.
[4] Total Allowable Catch (TAC) set for April-March fishing year for Canadian commercial fishery. Prior to 1988 the Atlantic Halibut catch was unregulated.
[5] Landings for 2015 are preliminary, from Maritimes Fisheries Information System (MARFIS) as of November 23, 2015.

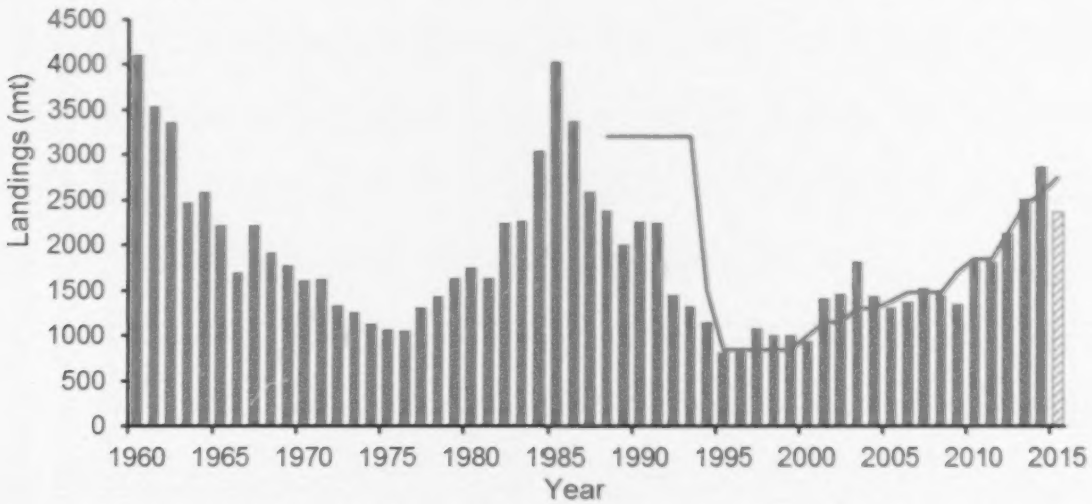

Figure 2. NAFO reported Canadian and foreign landings (metric tonnes) for 3NOPs4VWX5Zc Atlantic Halibut. See Table 1 for notes. The 2015 landings (hashed bar) are incomplete. The red line is the Canadian TAC.

Analysis and Response

A new framework was adopted in November 2014 (Cox et al. 2016). This framework uses a new statistical catch-at-length (SCAL) model to assess the stock status and an operating model (HAL) to evaluate the impact of a suite of harvest strategies on the biomass/population trends and landings. In March 2015, the Scotia Fundy Groundfish Advisory Committee adopted a F=0.14 harvest strategy with a cap on annual changes in TAC of 15%. Stock status in interim years is assessed based on the Halibut Survey index of exploitable biomass and the 4VWX RV survey. Science advice on TAC is based on the most recent 3-year mean Halibut Survey index of exploitable biomass. If the RV survey index falls below the long-term mean in 3 of the most recent 5 years, an assessment could be triggered.

4VWX RV Survey

The Scotia-Fundy groundfish RV survey has been conducted every July since 1970. The median size of halibut caught in the trawl survey is between 40 and 50 cm. The catch of Atlantic Halibut in the 4VWX RV survey increased between 2000 and 2011 (Figure 3). Since 2011 catch rates have remained above the long-term mean, with these in 2015 being the third highest in the time series (DFO 2016).

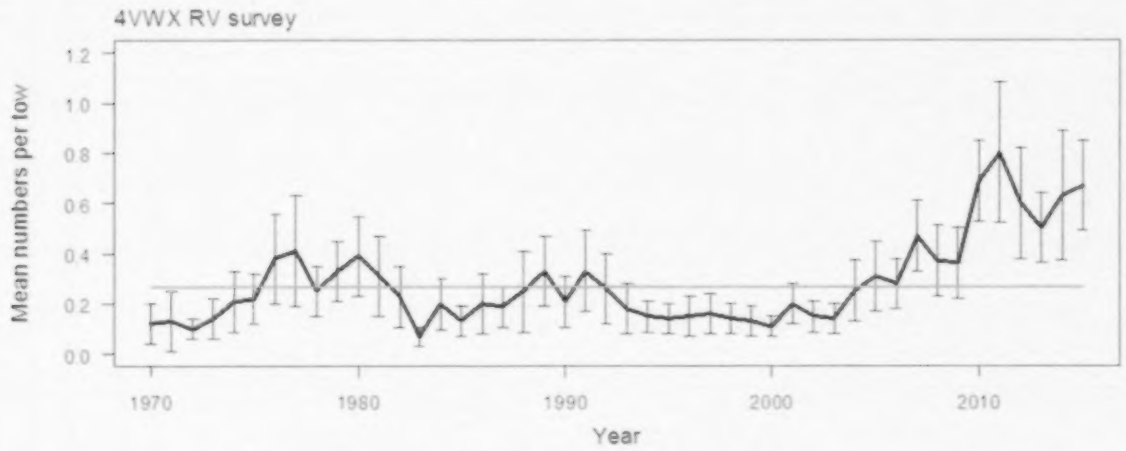

Figure 3. Plot of standardized mean number of halibut per tow for Scotia-Fundy Research Vessel Groundfish Survey sets in 4VWX from 1970 and 2015. The grey horizontal line is the long-term (1970-2014) mean (mean=0.27 per tow). The vertical bars indicate 95% confidence intervals.

Halibut Survey

The industry-DFO longline Halibut Survey provides an index of abundance of halibut ranging in size between 50 and 220 cm. The survey is completed by commercial fishermen with onboard observers between May and August. Halibut Survey catch rates were standardized using a generalized linear model (GLM) including both station and year effects. The catch rate has increased since 2004, with the 2015 standardized catch rate from the GLM being the highest in the 18-year time series (Figure 4). The long-term (1998-2014) mean is 56 kg/1000 hooks/10 hours and the 3-year mean (2013 -2015) is 116.

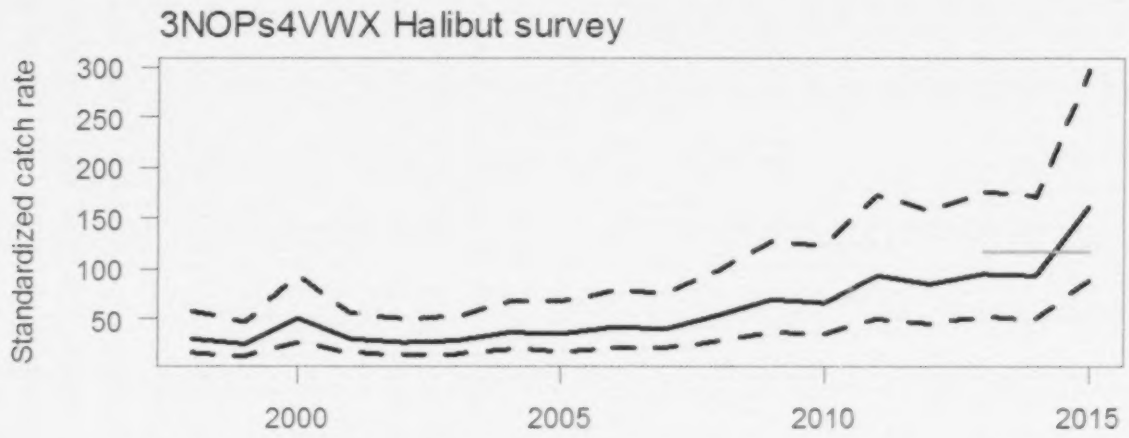

Figure 4. Plot of standardized catch rate (kg/1000 hooks/10 hrs) from the generalized linear model (GLM) of 3NOPs4VWX halibut survey fixed stations completed in 5 or more years since the beginning of the survey. The solid black line is predicted catch rate; the dashed lines indicate 95% confidence intervasl. The 3-year mean (solid grey line) is also plotted.

Harvest Control Rule

Using a correction for catchability (q) from the assessment model, the 3-year mean exploitable biomass is 24,306 mt (Figure 5) in 3NOPs4VWX5Zc. Applying the F=0.14 strategy with a maximum change of 15% from the 2015 TAC (2,738 mt) results in an increase in the 2016-2017 TAC to 3,149 mt. This application of the harvest control rule and the projections from the HAL model (DFO 2015) assumes all removals from Canadian and international fisheries are included.

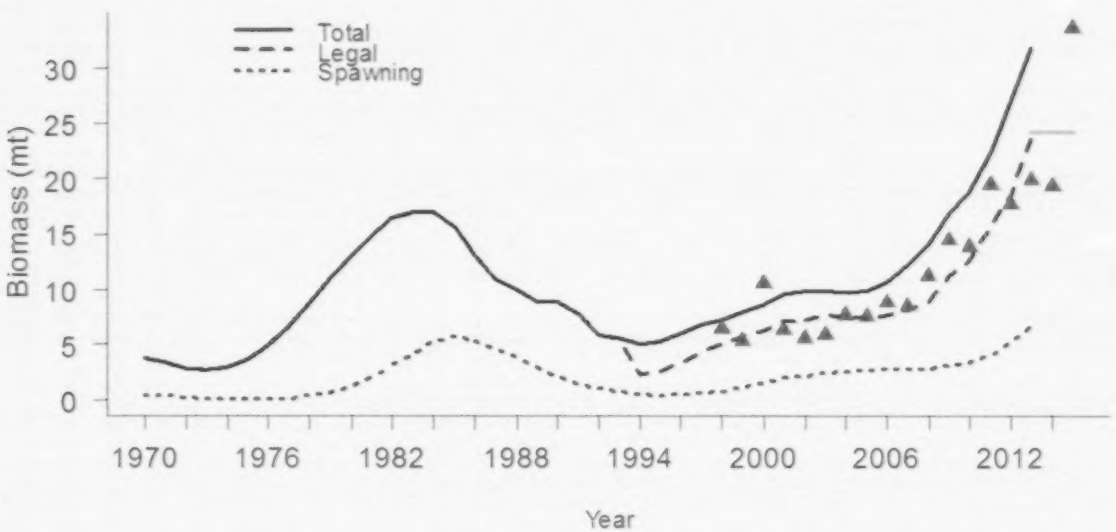

Figure 5. Plot of halibut biomass estimated between 1970 and 2013 from the stock assessment model (black lines) and the halibut survey (blue triangles). The solid line is total biomass, the dashed line is legal biomass, and the dotted line is spawning stock biomass. The solid grey bar is the 3-year mean.

Multi-year Mark-Recapture Tagging Model

In 2006, DFO and the Atlantic Halibut Council (AHC) began the Halibut All Sizes Tagging (HAST) program to estimate population size, exploitation rate and evaluate the distribution of halibut within the Scotian Shelf southern Grand Banks management unit (den Heyer et al. 2015). As of September 29, 2015, 747 of the 4,146 halibut that were double tagged with t-bar anchor tags between 2006 and 2014 were recaptured with sufficient information to be used in the multi-year mark-recapture model. Assuming 80% tag reporting and 100% survival from tagging, F is declining from a high of 0.18 in 2008 to a low of 0.05 in 2014 (Figure 6). The estimates of F from the tagging model are not directly comparable to the assessment model, but they provide an independent indicator of the trend in F.

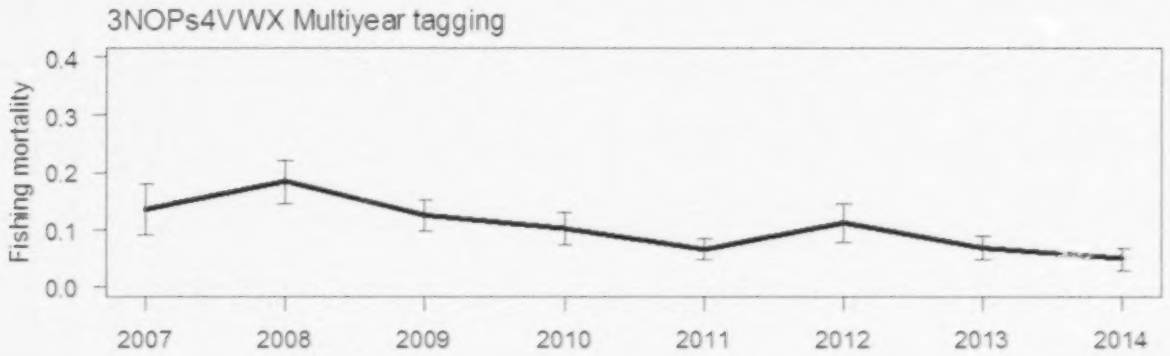

Figure 6. Plot of instantaneous fishing mortality estimated from the multi-year tagging model. The vertical bars indicate 95% confidence intervals.

Conclusions

The 3NOPs4VWX5Zc Atlantic Halibut stock has a history of overfishing that predates the time series used in the stock assessment model (i.e. prior to 1970). The assessment model indicates that the stock has increased from the depleted state observed in the early 1990s. The updated 4VWX RV survey and the 3NOPs4VWX5Zc industry-DFO Halibut Survey indices show that abundance of both pre-recruits and recruits continues to be high. The 2015 4VWX RV index remains above the long-term mean and suggests that the fishery will continue to benefit from high recruitment in the next couple of years. Further, F estimated from the multi-year mark-recapture model has been declining.

As forecast by the operating model, the index of legal-sized (greater than 81 cm) halibut biomass continues to increase, with 2015 being the highest in the 18-year time series. The 3-year mean (2013-2015) of the exploitable biomass (B_{legal}=24,306 mt) has increased from last year (2012-2014 B_{legal}=20,960 mt). A TAC of 3,149 mt in 2016 is consistent with the Harvest Strategy adopted by the SFGAC.

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Sources of Information

Cox, S.P., A. Benson, and C.E. den Heyer. 2016. Framework Stock Assessment for Atlantic Halibut on the Scotian Shelf and Southern Grand Banks. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/001.

den Heyer, C.E., B. Hubley, D. Themelis, S.C. Smith, S. Wilson, and G. Wilson. 2015. Atlantic Halibut on the Scotian Shelf and Southern Grand Banks: Data Review and Assessment Model Update. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/051: v + 82 p.

DFO. 2015. 2014 Assessment of Atlantic Halibut on the Scotian Shelf and Southern Grand Banks (NAFO Divisions 3NOPs4VWX5ZC). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/012.

DFO. 2016. 2015 Maritimes Research Vessel Survey Trends on the Scotian Shelf and Bay of Fundy. DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/011.

Stobo, W., J.D. Neilson, and P. Simpson. 1988. Movements of Atlantic halibut (*Hippoglossus hippoglossus*) in the Canadian North Atlantic: Inference Regarding Life History. Can. J. Fish. Aquat. Sci. 45: 484-491.

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